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Composition and seasonal changes of the microcrustacean fauna of sodic waters near Fülöpháza (Kiskunság National Park, Hungary)

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ABSTRACT. 41 species of Cladocera and Copepoda were found in five sodic pans situated in the vicinity of the village Fülöpháza between 1978 and 1986. Most of these species are common in Hungarian sodic waters. Moina salina was found here for the first time in Hungary. Usually, few species dominate in the plankton. A clear seasonal succession was observed in zooplankton composition. In cold season one of the two diaptomids, Arctodiaptomus spinosus and A. bacillifer, occurred with Daphnia magna. In warm periods two further species of Cladocera, Diaphanosoma brachyurum and Moina brachiata were dominant in companion with these diaptomids.

KEY WORDS: Cladocera, Copepoda, seasonal succession, small sodic pans

A good deal of the sodic waters in the Carpathian Basin can be found in the Great Hungarian Plain, many of them in the region between the rivers Danube and Tisza. Due to various human activities their number decreased greatly in the last decades. Kiskunság National Park was established in 1975 and it includes the sodic pans near Fülöpháza, too.

Zoological studies concerning Hungarian sodic waters started almost 100 years ago, for a review see PONYI (1961) and MEGYERI (1972). Extensive studies have been carried out on the Fülöpháza pans by a team between 1972 and 1974: geology was studied by MOLNÁR (1976), phytoplankton by KISS (1975), zooplankton by MEGYERI (1975), and zoobentos by FERENCZ (1976).

Since 1978 I have worked on the Cladocera and Copepoda fauna of these pans. In 1979 I carried out frequent sampling in order to detect seasonal changes. This paper reports the faunistical results of my studies between 1978 and 1986. The seasonal changes observed in 1979 are outlined.

MATERIALS AND METHODS

Study sites

The sodic pans near Fülöpháza (Kondor-tó, Szappanosszék, Szivósszék, Hattyusszék) (Fig. 1) and the sand dunes west of them form the IV. basic unit of the Kiskunság National Park. A detailed description of the national park is given by TÓTH (1979).

In this lowland area between the rivers Danube and Tisza in Middle Hungary, the climate is continental with uneven spatial and temporal distribution of precipitation and negative water balance (average annual rainfall is 500-550 mm, lower than potential evapotranspiration of 680-700 mm). Mean annual temperature is 10-11°C, January is the coldest (-1.5 — -2°C) and July is the warmest (21-22°C) month. Mean daily temperature is above 10°C from middle April to middle October. Groundwaters have very slow horizontal current

and high Na_2CO_3 - $NaHCO_3$ content. The salt concentration in the groundwater around the pans is 700-4 000 mg/l (MOLNÁR 1976).

The pans are in depressions formed by wind at the beginning of the Holocene. These are very shallow waters with maximum depth ranging from 50 to 100 cm. Their surface area is relatively large, between 8 and 35 ha. Three of them have large areas covered with reed, the exception is Szappanosszék, where only small patches of reed can be found. Table 1 provides some information about the chemical features of them after KISS (1975).

Kondor-tó is divided into two parts, they are referred to as northern and southern part in this paper. They are merely connected by a channel in the reedbelt. Such a distinction was not used by MEGYERI (1975). He noted that the pans were in natural condition except Kondor-tó, since in its northern basin intensive duck breeding had taken place for some years. Both Szappanosszék and Hattyusszék were in closed basins in 1979, while in Szivósszék a canal was introduced.

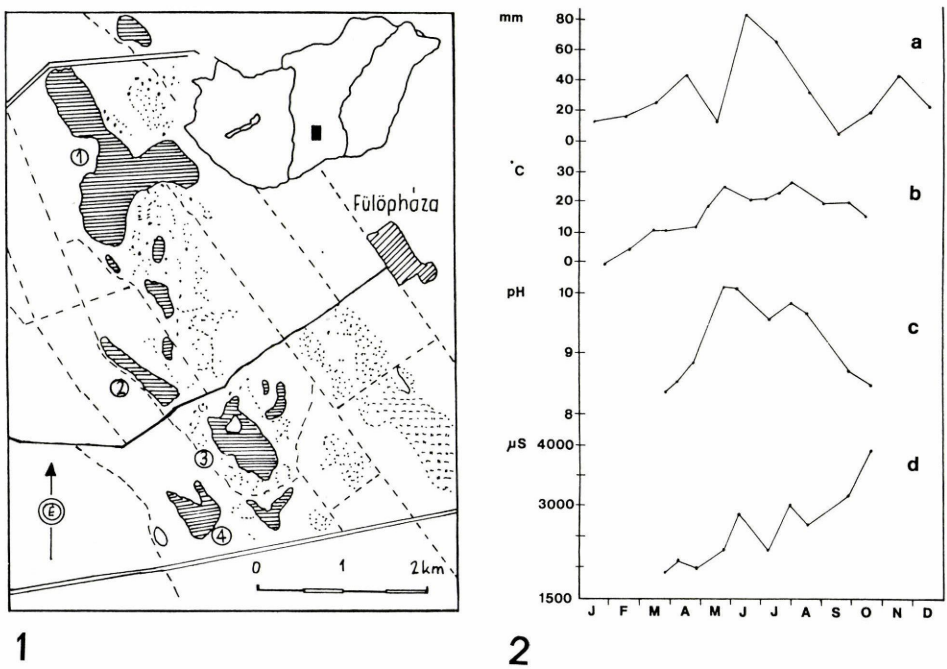
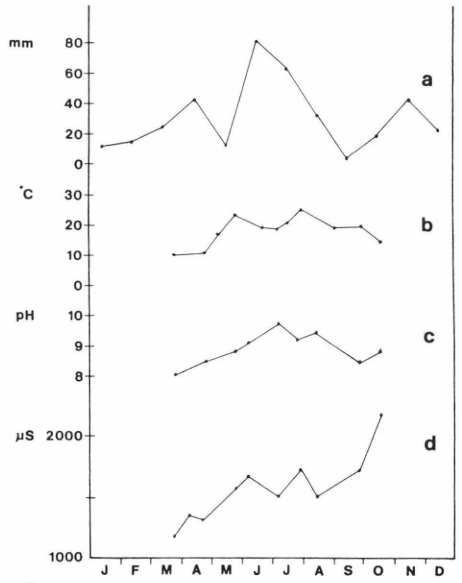


Fig. 1. Map showing position of Fülöpháza (inset) and of the pans
(1= Kondor-tó, 2= Szappanosszék, 3 = Szívósszék, 4 = Hattyússzék)
Fig. 2. Seasonal changes of some environmental variables in 1979 in Kondor-tó, northern part
(a= rainfall, b= water temperature, c= pH, d= conductivity)

Sampling

Qualitative zoological samples were taken by a plankton net of 100 µm mesh size, from both open and vegetated areas of the pans between 1978 and 1986.

Monthly-bimonthly sampling was carried out in 1979, when from each pan samples of 15 l were collected as long as water depth allowed it. However, they are not considered quantitative samples, and they are used only to give estimation of relative abundance.



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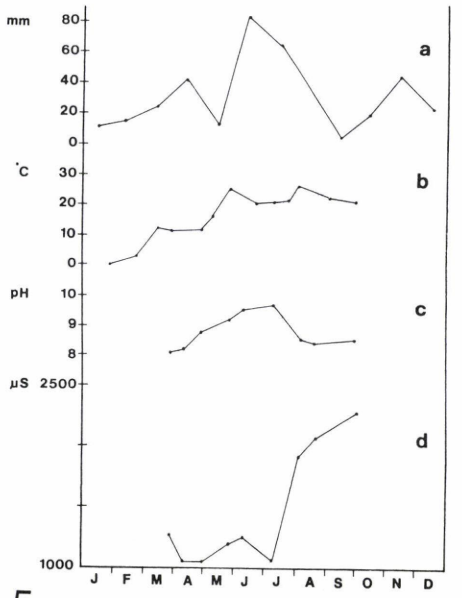

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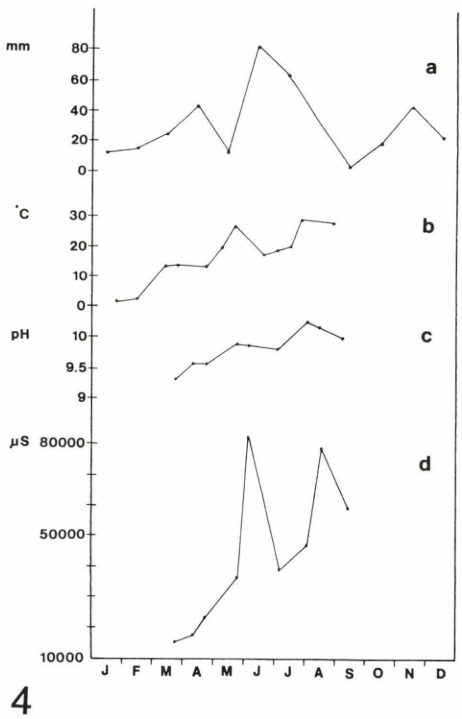

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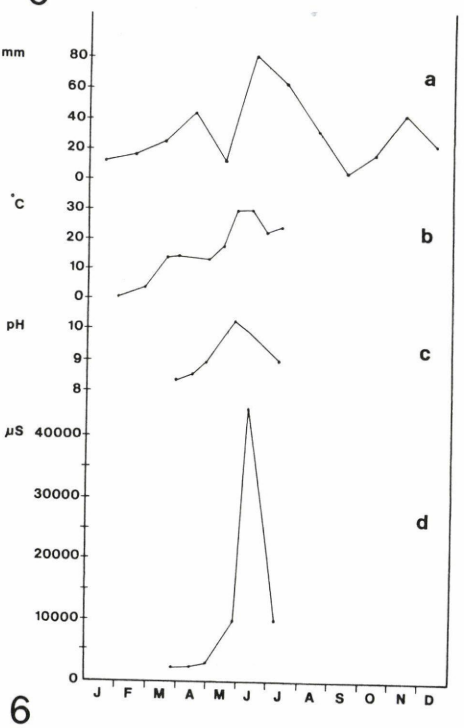

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Figs 3-6. Seasonal changes of some environmental variables in 1979 in the pans (3= Kondor-tó, southern part, 4= Szappanosszék, 5= Szívósszék, 6= Hattyússzék) (for further explanation see Fig. 2)

Table 1.

Minimum and maximum values of some chemical features in 1972-1974
(after Kiss 1975)

Locations	pH	alkalinity	conductivity	total dissolved solids	Na^+	K^+	Ca^{++}	Mg^{++}	HCO_3^-	CO_3^{--}	SO_4^{--}	Cl^-	dissolved oxigen
		W	µS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Kondor-tó	8.85-9.95	24.0-189.0	2.200-19.000	1.800-13.220	327-3432	8-211	191-892	14-134	317-2345	108-713	16-350	74-760	0.0-13.2
Szappanos-szék	9.25-10.30	135.4-294.0	13.300-32.000	9.520-22.620	3850-7843	196-1280	0.0-34	4.9-277	586-6260	980-6900	39-2180	109-3900	4.2-14.9
Szivós-szék	8.7-9.55	38.77-74.10	3.880-8.000	2.500-6.550	791-2260	8-200	48-170	1.1-47	1240-2670	312-910	16-1580	145-364	1.9-13.2
Hattyus-szék	9.1-9.85	38.80-76.90	5.000-8.500	3.500-6.200	1190-2240	31-106	22-82	7.3-40	1560-2550	396-1400	250-975	410-770	4.4-16.5

1979 was a rather dry year, the rainfall was only 385 mm. Zoological samples were collected between 30 January and 18 December chemical samples were taken between 22 March and 15 October.

RESULTS AND DISCUSSION

Faunistical aspects

In the sodic pans at Fülöpháza forty one microcrustacean species (one anostracan, 27 Cladocera and 13 Copepoda) were found between 1978 and 1986 (Table 2). Moina salina Daday was recorded for the first time in Hungary, a detailed account of this record was given elsewhere (FORRÓ 1988).

There was a great variation in the number of species recorded in the individual pans. Szivósszék had the greatest number, thirty three species occurred here, while the minimum, seven species were found in Szappanosszék. Twenty - twenty two species were recorded in the other three pans (Table 2). The great difference between maximum and minimum values is very likely due to the difference between the salinity values of these pans in 1979 (for a comparison of conductivity values see Figs 4 and 5).

MEGYERI (1975) reported the occurrence of sixteen species in these pans between 1972 and 1974. He found the maximum number of species in Kondor-tó, and the minimum in Szappanosszék. The reason why a greater number of species is recorded in the present study may be the frequent sampling in 1979 and the changes in the chemistry of Szivósszék. This pan was rather sodic in the time of MEGYERI's work, while in 1979 the conductivity was rather slow, it indicates a sharp decrease in salinity; the pan has actually lost its sodic character.

MEGYERI (1975) found 11 Cladocera and 4 Copepoda species in these pans, most of them are widely distributed in Hungarian sodic waters. In my samples many species were found which are typical of littoral areas of various lakes. This is indicated by the much greater number of cyclopoid species, too. The number of chydorid species has also increased. Another interesting point is the occurrence of Polyphemus pediculus in Kondor-tó, which is the fourth record of this species in sodic waters in Hungary.

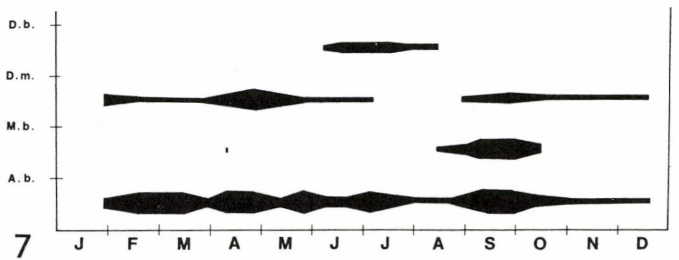
Four species occurred in each pan: Daphnia magna, Moina brachiata, Macrothrix hirsuticornis and Megacyclops viridis. Arctodiaptomus spinosus was very abundant in each season, it occurred also in Szivósszék, however, it was not found in the northern basin of Kondor-tó. In this latter pan A. bacillifer was recorded, and it also appeared in other pans except for the highly sodic Szappanosszék.

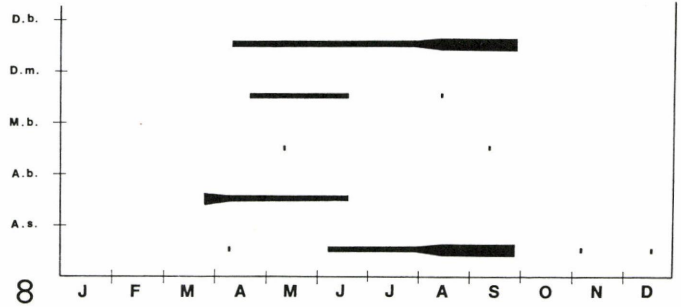
Seasonal changes

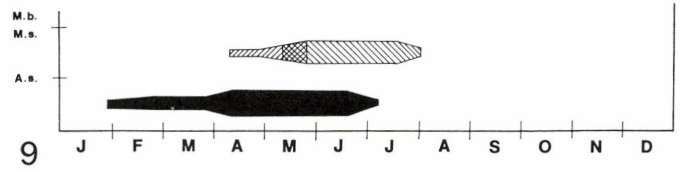
In the northern part of Kondor-tó water temperature varied from 0.8 to 28.4°C; in middle March it was above 10°C in May it exceeded 20°C and dropped below this value only in October. The pH fluctuated between 8.42 and 10.19, the maximum value occurred in May probably due to the photosynthetic activity of an algal bloom. The conductivity almost continuously increased up to late autumn, from 1940 µS to 3920 µS. In July it decreased with 600 µS, which is certainly the effect of a rainfall (Fig. 2).

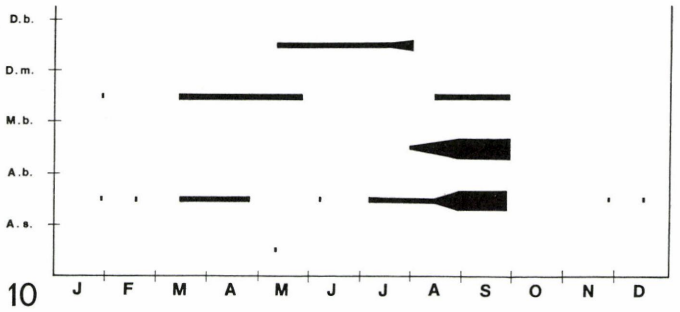
17 Cladocera and 5 Copepoda species were found here. The maximum number of species, 13, was observed at the end of April, with the majority of species in samples from vegetated areas. Arctodiaptomus bacillifer was collected at all occasions, while A. spinosus did not occur in this pan. Three Cladocera species accompanied with A. bacillifer during the year. Daphnia magna in the cold season, in winter, spring and in late autumn again, Diaphanosoma brachyurum occurred in summer and Moina brachiata was abundant from August to middle October (Fig. 7). Macrothrix hirsuticornis was also frequently found in summer samples. Of the cyclopoids, Megacyclops viridis was the most frequent, occurring in almost all samples, from vegetated areas.

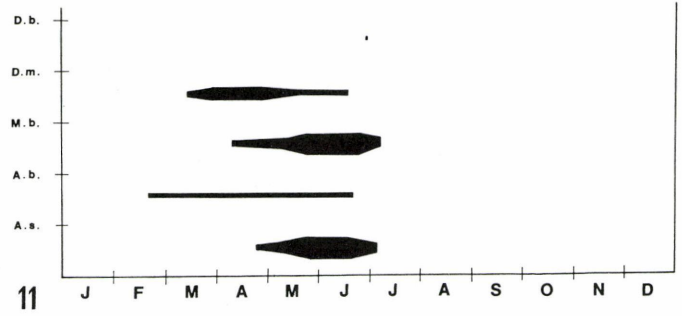
In the southern part of Kondor-tó temperature and pH were similar to that of measured in the northern part, with a bit smaller values here. The differences in conductivity were much greater between the two parts. It varied from 1220 to 2200 µS, and the rainfall











Figs 7-11. Seasonal variation in the occurrence of dominant species in the pans in 1979 (7= Kondor-tó, northern part, 8= Kondor-tó, southern part, 9= Szappanosszék, 10= Szívósszék, 11= Hattyússzék) (D.b. = Diaphanosoma brachyurum, D.m. = Daphnia magna, M.b.= Moina brachiata, M.s.= Moina salina, A.b. = Arctodiaptomus bacillifer, A.s. = Arctodiaptomus spinosus)

Table 2.

List of species recorded in the sodic pans near Fülöpháza between 1978 and 1986

	Kondor-tó I.	Kondor-tó II.	Szappanos-szék	Szívós-szék	Hattyús-szék
ANOSTRACA					
Branchinecta ferox Milne-Edwards, 1840			+		+
CLADOCERA					
Diaphanosoma brachyurum (Lievin, 1848)	+	+		+	+
Diaphanosoma lacustris Korinek, 1981				+	
Daphnia magna Straus, 1820	+	+	+	+	+
Daphnia atkinsoni Baird, 1859					+
Daphnia pulex Leydig, 1860	+			+	
Daphnia longispina O. F. Müller, 1785	+	+		+	
Simocephalus expinosus (Koch, 1841)	+			+	+
Simocephalus vetulus (O. F. Müller, 1776)	+			+	
Ceriodaphnia reticulata (Jurine, 1820)	+	+		+	+
Ceriodaphnia laticaudata P. E. Müller, 1867				+	
Ceriodaphnia quadrangula (O. F. Müller, 1785)		+		+	
Scapholeberis rammneri Dumont et Pensaert, 1983	+			+	
Scapholeberis mucronata (O. F. Müller, 1785)	+	+			+
Megafenestra aurita (Fischer, 1849)					+
Moina brachiata (Jurine, 1820)	+	+	+	+	+
Moina salina Daday, 1888			+		
Macrothrix rosea (Jurine, 1820)				+	+
Macrothrix hirsuticornis Norman et Brady, 1867	+	+	+	+	+
Oxyurella tenuicaudis (Sars, 1862)	+			+	+
Graptoleberis testudinaria (Fischer, 1851)		+			
Alona rectangula Sars, 1862	+	+		+	+
Dunhevedia crassa King, 1853	+			+	
Alonella excisa (Fischer, 1854)	+			+	
Pleuroxus aduncus (Jurine, 1820)		+		+	
Chydorus sphaericus (O. F. Müller, 1785)	+	+		+	+
Chydorus latus Sars, 1862				+	+
Polyphemus pediculus (Linné, 1761)		+			
COPEPODA					
Arctodiaptomus bacillifer (Koelbel, 1885)	+	+		+	+
Arctodiaptomus spinosus (Daday, 1890)		+	+	+	+
Mixodiaptomus kupelwieseri (Brehm, 1907)		+		+	
Eucyclops serrulatus (Fischer, 1851)		+		+	
Paracyclops affinis (Sars, 1863)				+	
Cyclops strenuus strenuus Fischer, 1851	+			+	
Cyclops vicinus vicinus Ulianine, 1875	+	+		+	
Acanthocyclops vernalis (Fischer, 1853)	+			+	
Megacyclops viridis (Jurine, 1820)	+	+	+	+	+
Diacyclops bicuspidatus (Claus, 1857)	+			+	+
Diacyclops biselosus (Rehberg, 1880)		+		+	+
Cryptocyclops bicolor (Sars, 1863)				+	
Microcyclops varicans (Sars, 1863)					+

in July caused only 200 µS decrease in conductivity (Fig. 3). It was less here than in the northern part in all cases and the extent of seasonal variation is roughly half of that in the other basin.

18 species were found here, species number varied from 2 to 9, maximum occurred in early June. Daphnia magna was less abundant here, while Diaphanosoma brachyurum occurred for a much longer time, from early April to late September continuously. Moina brachiata was less important here, it occurred only twice, in May and in September. Besides the frequent Daphnia longispina, Ceriodaphnia reticulata and Alona rectangula, Polyphemus pediculus was also found here in late April. Three diaptomids and four cyclopids composed the copepod fauna of this pan. Mixodiaptomus kupelwieseri appeared in April. Both A. spinosus and A. bacillifer occurred in this pan. A bacillifer and A. spinosus were collected from spring to middle June and from early June throughout the year, respectively (Fig. 8). Of the four cyclopoids, M. viridis was the most abundant one here, too, but only for a shorter period.

Szappanosszék was the most sodic of the pans in 1979, it was completely dry in September. Water temperature was 13.9 °C as early as in March and the maximum, 30.2 °C was measured in late July. The pH varied between 9.35 and 10.31, conductivity was high already in March, 15 740 µS, maximum was 83 300 µS in June. The rainfall in June resulted in a sharp decrease in conductivity, afterwards it increased again (Fig. 4). These data show that the pan was extremely sodic in 1979, this is reflected in the microcrustacean fauna, too. In 1979 merely four species occurred here, but two of them, Daphnia magna and Megacyclops viridis were represented by one specimen. Some years later, in 1985 and 1986, when conductivity was lower (about 10 000 µS before drying out), these species were more abundant, and Macrothrix hirsuticornis also occurred.

In 1979 the dominance of three species, Moina brachiata, M. salina and Arctodiaptomus spinosus indicates high salinity and alkalinity values in this pan. The occurrences of these species are shown in Fig. 9.

Szívósszék was the least sodic pan, changes in water temperature were similar to that of in Szappanosszék. The smallest pH and conductivity values were measured in this pan, pH changed between 8.1-9.85. In spite of the fact, that the pan dried out in October, conductivity fluctuated only between 1060-2300 µS. It was gradually increasing throughout the year, the rainfall in June caused very small decrease (Fig. 5). Both the maximal value and the extent of seasonal variation was the smallest in this pan.

The greatest number of species, 18 Cladocera and 12 Copepoda, occurred in this pan in 1979. The species number in late March was the greatest here (17 species). The occurrences of abundant Cladocera species are similar to those of in Kondor-tó, southern part. The copepod fauna is also similar, the same three diaptomids occurred here as in the southern basin of Kondor-tó. However, A. spinosus played here an insignificant role, it was found on two occasions only, A. bacillifer was more important (Fig. 10). All these facts, particularly the decline of A. spinosus refer to fundamental changes in the chemistry of this pan.

Hattyússzék is the smallest one of these pans, it dries out each year. It was the warmest pan, temperature varied between 1.4-31.6°C. In March it was 14°C. Both pH and conductivity showed great fluctuations (Fig. 6), pH varied between 8.47 and 10.41. Conductivity changed from 2700 to 46 500 µS between March and June, considerable decrease was measured after the rainfall in June. Thereafter the pan was dry.

22 taxa occurred in Hattyusszék in 1979. The number of species varied between 2 and 17, with a maximum in early May. The composition of microcrustacean fauna reflects both the sodic and astatic nature of the pan (e.g. occurrence of A. spinosus, on the other hand the occurrence of Branchinecta ferox and Daphnia atkinsoni) Arctodiaptomus bacillifer occurred from February to late June, A. spinosus was found from middle March until there was water in the pan. This latter species was the only one that occurred in the sample before the pan dried out (Fig. 11).

CONCLUSIONS

Forty one microcrustacean species occurred in the qualitative samples taken from five sodic pans between 1978 and 1986. This number is much greater than that recorded by MEGYERI (1975) between 1972 and 1974. Besides different sampling methods used the increase in species richness might certainly be attributed to the changes in water chemistry of the pans (salinity decreased in Szivósszék, and also in Szappanosszék).

Monthly - bimonthly sampling showed various seasonal changes in the different pans. Conductivity fluctuation was greater in pans of smaller size, but the extent of its seasonal variation was also related to mean salinity. These results (closely) agree with the findings of BAYLY and WILLIAMS (1966) and WILLIAMS (1977). The various "plankton types" - as defined by MEGYERI (1959) - could be observed. They were composed of two diaptomid and three cladoceran species. The time and duration of their occurrences in the individual pans were dependent on temperature, salinity and turbidity.

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